Formative Assessment

1. Water flows at 0.140 m/s down a pipe with an inner diameter of 1.27 cm. If the pipe widens to an inner diameter of 5.08 cm, what is its velocity? (0.00875 m/s)

2. How fast does air leak out of a small hole in a tire that is at 32.0 psi gauge? Ignore viscosity, and use 1.29 kgm^{-3} as the density of air.
(585 m/s)

3. Water ($\rho = 1000.\ kgm^{-3}$) is moving at 2.35 m/s down a pipe with an inner diameter of 3.40 cm and is at a pressure of 9830 Pa at a height of 1.17 m. It changes elevation and the pipe narrows to 2.95 cm inner diameter and the pressure changes to 12,400 Pa. What is the new elevation? (Assume laminar flow. haha) (0.693 m)

4. A tiny drop of water ($\rho = 1000.\ kgm^{-3}$) has a terminal velocity of 0.00315 m/s through air with a viscosity of 1.81×10^{-5} Pa s. What is its radius? (Ignore the buoyant force of the air) (5.11×10^{-6} m or 5.11 μm) - (it's 5.12 μm if you take into account the buoyancy of air)

5. What is the maximum speed water can move down a 5.08 cm diameter pipe if it is to have a Re_r (what our equation calculates) that is less than 1000? (use $\rho = 1000.\ kgm^{-3}$, $\eta = 1.10x10^{-3}$ Pa s)
(0.0433 m/s)

2. An HVAC duct that is 1.02 m in diameter supplies air to a 10.0 m x 4.20 m x 21.0 m room at a rate of 3.50 ACH. What is the air speed in the duct? (3.50 ACH means it replaces the air 3.50 times per hour, so it does it once in (3600 s)/3.5 seconds) (1.05 m/s)

5. A pipe bursts in a classroom that is 12.0 m x 35.0 m in floor area. If it is a 5.08 cm diameter pipe, and the water is going 20.3 m/s, what depth will the water be in a hour if it does not leak? (35.3 cm)

6. A 0.75 inch pipe with water going 4.5 inches per second narrows to 0.50 inches inner diameter. What is the velocity in the narrow part? (10. inches/sec)

8. A circular 2.50 cm diameter pipe has a flow velocity of 56.0 cm/s. What is the diameter of the pipe if the flow velocity slows to 13.0 cm/s? (5.19 cm)

11. Water issues from hole in the side of a water tank at 12.0 m/s. What is the height of the water in the tank above the hole? ($\rho = 1000.$ kgm^{-3}) Assume atmospheric pressure above the water in the tank and at the hole. (7.34 m)

12. Air ($\rho = 1.29\ kgm^{-3}$) streams at 6.70 m/s through a hole in a wall. What is the pressure difference from one side to the other? (29.0 Pa)

13. The air is traveling at 45.0 m/s over the top of a wing, and 43.0 m/s over the bottom of a wing. What is the pressure difference from one side to the other? (114 Pa)

14. Water is at 1.035×10^5 Pa in a level pipe where the velocity is 2.40 m/s. If the pressure drops to 1.024×10^5 Pa, what is the velocity? (2.82 m/s)

15. Water moves at 1.70 m/s down a level pipe at a pressure of 1.015×10^5 Pa. What is the pressure if the water speeds up to 4.92 m/s? (9.08×10^4 Pa)

19. A 3.50 cm diameter pipe carries water at 4.10 m/s at an elevation of 6.30 m and a pressure of 1.24×10^5 Pa. The pipe widens out at an elevation of 5.10 m where the pressure is 1.43×10^5 Pa. What is the velocity here and the diameter of the pipe? (1.53 m/s and 5.72 cm)

17. Water moves at 3.50 m/s down a 4.80 cm diameter pipe at an elevation of 3.80 m and a pressure of 1.26×10^5 Pa. At a different elevation the pipe narrows to 3.60 cm in diameter and is at a pressure of 1.36×10^5 Pa. What is the elevation here? (1.43 m)

18. A 5.40 cm diameter pipe carries water at 3.70 m/s at an elevation of 3.40 m and a pressure of 1.56×10^5 Pa. At an elevation of 4.60 m the pipe narrows to 4.20 cm in diameter. What is the pressure in this part of the pipe? (1.32×10^5 Pa)

21. A droplet of water is 6.12 μm in diameter. What is its mass? What is its weight? What speed must it fall through air so that its Stokes drag is equal to its weight? (This is its terminal velocity)
(1.20×10^{-13} kg, 1.18×10^{-12} N, 0.00113 m/s)

23. A tiny grain of basalt ($\rho = 2920\ kgm^{-3}$) is 2.20 microns in diameter. What speed does it settle in water? (Don't ignore the buoyant force of water) (5.05×10^{-6} m/s)

24. A tiny grain of basalt ($\rho = 2920\ kgm^{-3}$) takes 27.0 minutes to settle from the top of a 8.50 cm tall test tube full of water to the bottom. What is its speed? What is its radius? What time would it take to settle in a 5.40 cm radius centrifuge spinning at 1200 RPM? (5.25×10^{-5} m/s, 3.54×10^{-6} m, 18.6 s)

26. Syrup with a viscosity of 1.20 Pa s and a density of 1080 kgm^{-3} needs to have turbulent flow down a pipe where it is heated. What speed must it go down a pipe that is 68.0 cm in diameter to ensure that it has a Re_r of 1200? (3.92 m/s)

28. What is the maximum speed air can flow down a 24.0 cm diameter duct to have a Re_r of 850? (9.94 cm/s)

30. What maximum diameter pipe can water flow down at 0.890 m/s to have a Re_r of 950? (2.14 mm)

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